

**J.L. Shepherd & Associates**

**BU650B**

**Design Review**

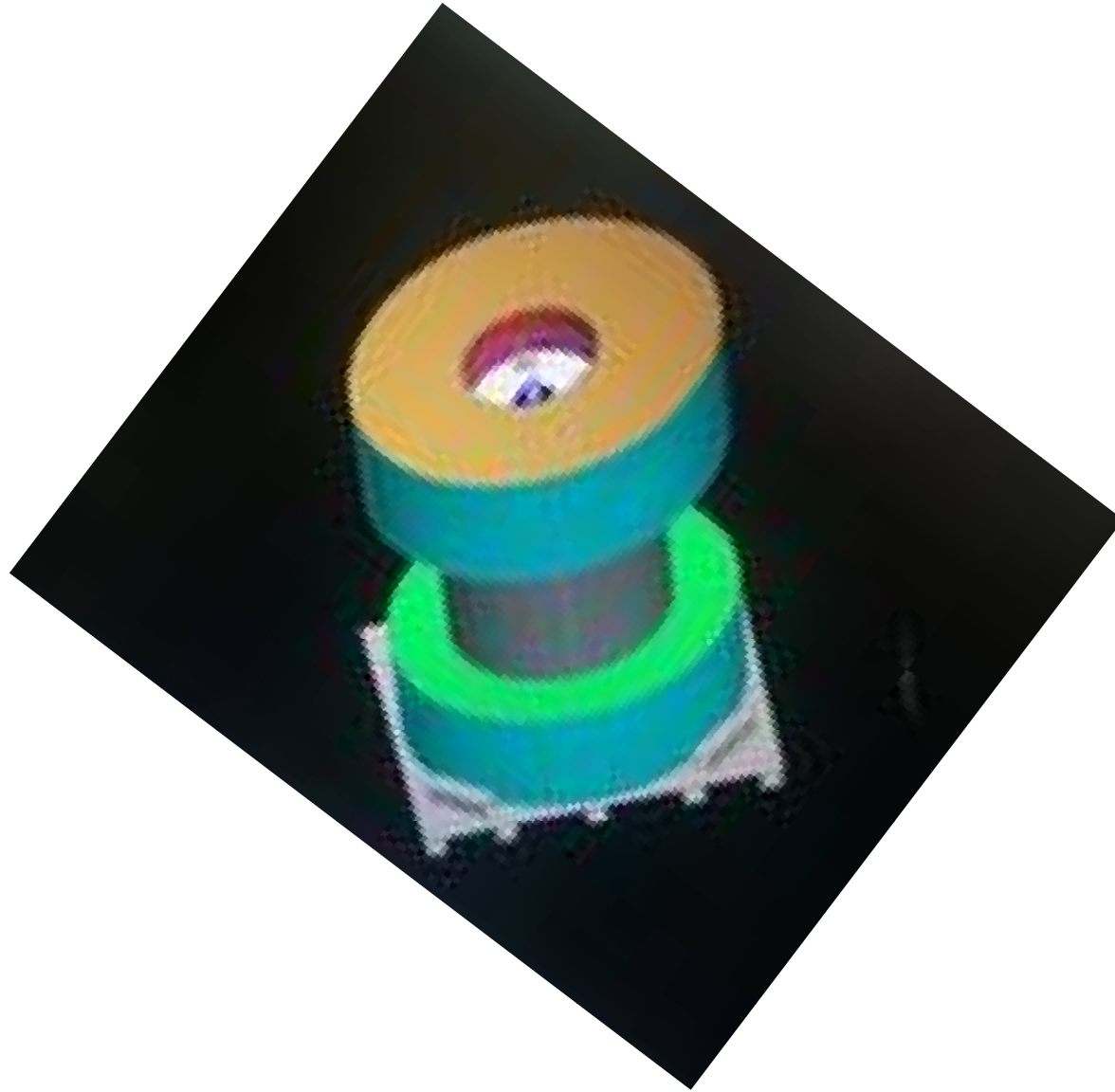
**Type B(U)**

**Radioactive Materials Transport  
Package**

## AGENDA

Introductions:	15 min.
Presentation of BU650B Public Portion:	30 min.
Presentation of BU650B Proprietary Portion:	30 min
Questions and Answers:	30 min
Conclusion:	15 min.

J.L. SHEPHERD & ASSOCIATES BU650B TYPE B(U) RADIOACTIVE MATERIALS TRANSPORT PACKAGE



## Design Basis (71.107)

- Provide a package capable of transporting SEALED SOURCES in Special Form (Co-60 & Cs-137)
  - Utilizes Shielded Liner concept
    - All Shielded Liners manufactured from similar materials and methods of construction
    - Shielded Liners have different shapes/sizes
    - Bounded by a maximum payload criteria
    - Representative Computer-aided Modeling of payload variations performed to substantiate purpose.



- Design Basis (71.107) cont'd.
  - Initial CoC application to consider largest Shielded Liner to be used
  - Subsequent application amendments to consider use of smaller Shielded Liner(s) in various configurations.

## **PACKAGE DESCRIPTION (71.33)**

- Maximum Gross Weight: ~12,500 pounds
- Useful Load: 6,500 pounds
- Transportation of “Sealed Sources” in Special Form Only. Special Form sources meet the requirements of §71.75.
  - 450 Watts (Decay Heat)
    - 29,250 Ci Co-60
    - 96,750 Ci Cs-137 (Cs-137 to be limited to 30,000 Curies only)
- Shielding is obtained through use of Shielded Liners
- Not intended for transport of fissile material or neutron sources
- No need for criticality control features
- Not intended for transport of gasses, liquids, or waste in any form.

## **Package Description (71.33)**

### **DIMENSIONS (With Impact Limiters Installed)**

- Inner Cavity is 35” diameter by 54” high.
- The overall height of the package is approx. 85”
  - 69” without impact limiters
- The outer diameter of the package is approx. 66.5”
  - 44.5” without impact limiters.

### **WEIGHT:**

- Estimated empty: 5,800 pounds (2636.4 Kg) (with Impact Limiters installed)
- Pay load: 6,500 pounds, maximum
- Shoring (if required) up to 200 pounds
- Maximum Gross Weight: 12,500 pounds ( 5681.8 Kg)

- Technical Description of Package (71.33)
  - Package body consists of an external 304 stainless steel shell and an internal 304 stainless steel shell.
  - The inner package bottom is comprised of an inner disc of 3/8" stainless steel plate, circumferentially welded to the inner wall.
  - The annular space between the inner and outer walls and bottom (4" ) is filled with a thermal barrier material known as "Kaolite 1600."
  - The extreme bottom of the package is fabricated from a disc of 1/2" stainless steel plate, circumferentially welded to the outer wall.
  - The closing ring and lid are fabricated from 304 stainless steel rings and discs in order to form an interior 4" pocket for thermal barrier; a rigid inner lid (1/2" thick plate); and a 2" tall "energy absorber" which sits atop the lid assembly. There is a lifting ring attached which is used for lifting of the lid only.
  - There are Impact Limiters installed at the top and bottom of the main package body.

## MAIN PACKAGE BODY

### CONSISTS OF:

1. LOWER PACKAGE ASSEMBLY
2. LID ASSEMBLY

- **THREE BASIC LID COMPONENTS**

1. Closing Ring

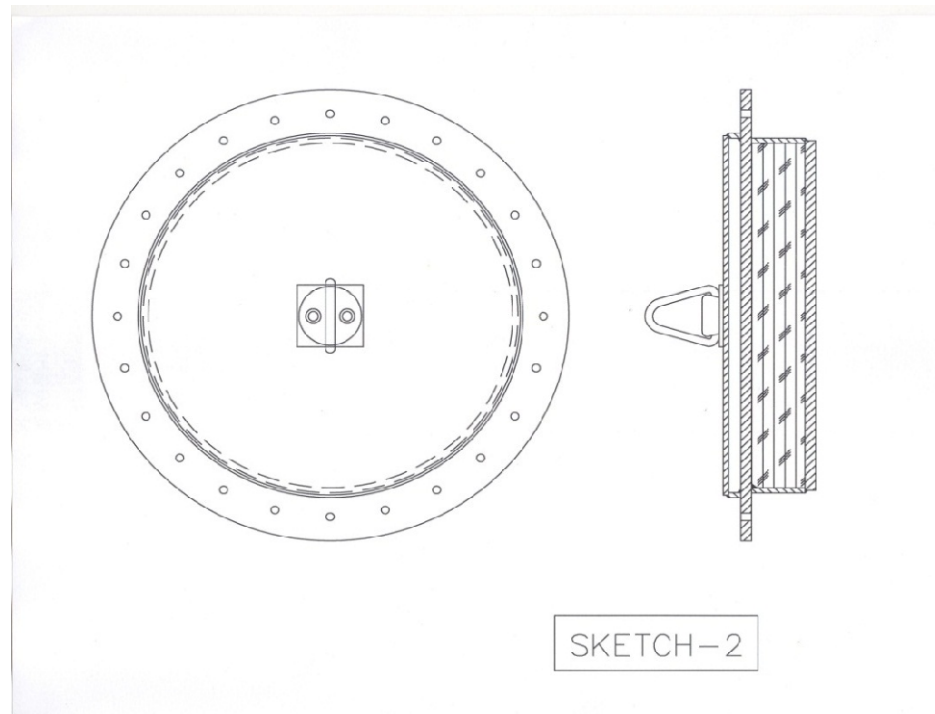
- Fully welded to Lower Package Assembly

2. Lid

- Top has a 2" energy absorber with lifting ring attached
- 24 Bolt Closure. Bolts are  $\frac{3}{4}$ -10 UNC x 2", 316 SS

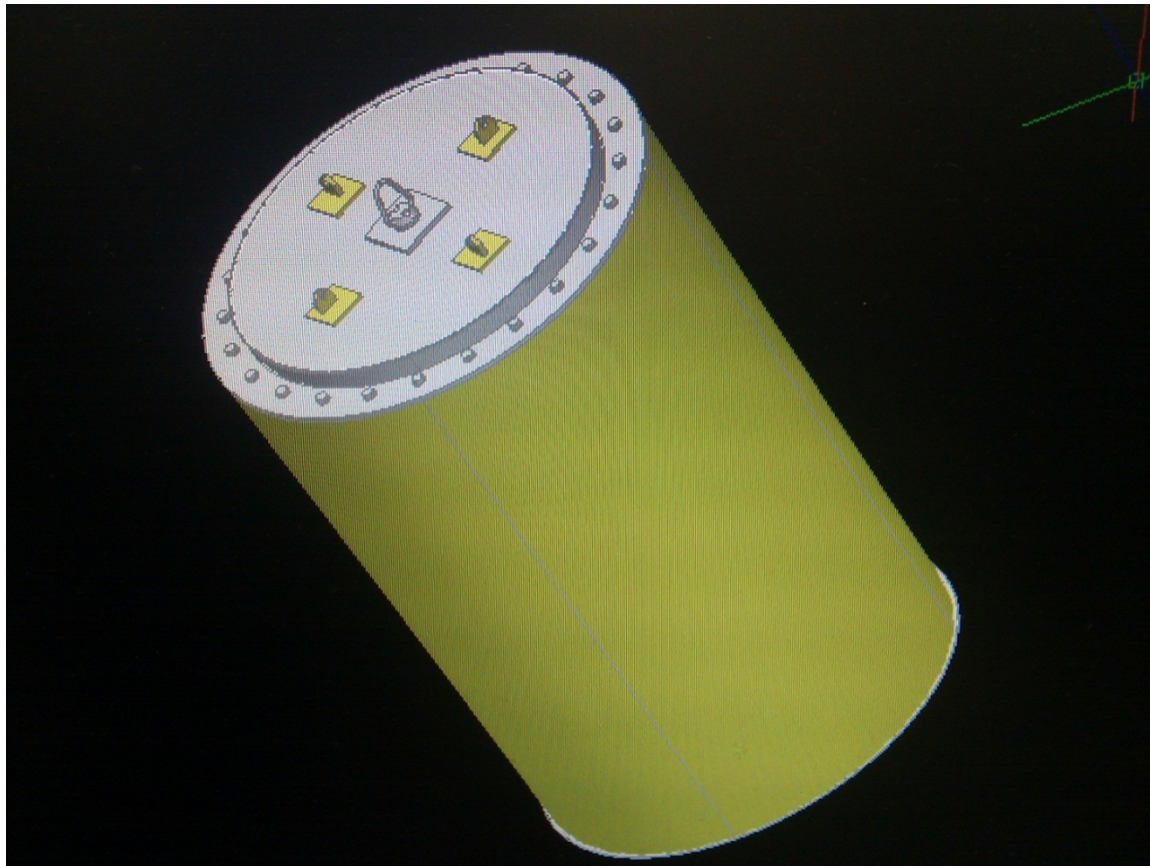
3. 4" thick Kaolite 1600 thermal barrier on the inner portion, fully contained in stainless steel.

## LID ASSEMBLY



Reference Only

## Lower Package Assembly





## Design and Intended Use allows for:

### – Rugged Construction

- Austenitic Stainless Steels used in construction – No Brittle Fracture
- Stainless steel walls, per ASTM Standard
- Stainless steel ends and lid, per ASTM Standard
- Fully welded, per ASME Section II, IX, and IX; AWS D1.1
- Easily installed/removed Impact Limiters (4 stainless steel pins & clips)

### – Ease of use.

- Bolt closure (Stainless Steel Hardware)
- No operational seals (Sources are sealed)
- Stainless Steel Pin and clip retention of Impact Limiters
- Standardized, durable cribbing/retaining media

## Design and intended use allows for (cont'd):

- Ease of Maintenance
  - 2 basic sub-assemblies
- Easy to follow routine inspection regimen
- Only 4 circumferential welds on Lower Package Assembly. Seam welds of inner and outer packages are not aligned. (Other components are sacrificial).
- Closure hardware easily obtainable. (Catalog parts carried by QA-approved, Nation-wide hardware distributors).

## **General Standards for All Packages (71.43)**

Materials and methods of construction provide excellent safety factors. LS-Dyna Modeling Calculations show that from a 30' drop, the

- Impact Limiter Assembly
  - Absorbs shock on impact (approx. 66% effective)
    - Top Drop
    - Bottom Drop
    - Corner Drops
    - Top Corner Drops (angular) (15° most damaging)
    - Bottom Corner Drops (angular)

## Lifting and Tie-Down Mechanisms

- TIE-DOWN Mechanism (Handling Only)
  - Package may be transported in covered van or via flatbed trailer
  - Package is secured to conveyance by blocking bars or chains extending through a spider frame which interface with the top of the Impact Limiter
    - Secondary security is provided by a set of chain chocks located at the base of the package pallet assembly. (Package nests on a specially made steel pallet designed for lifting and securing the package during transport).
- LIFTING (Handling Only)
  - The pallet is used for lifting purposes.
  - Lifting occurs by utilizing a forklift.

## **Opening and Closing, Subpart G (Part 71.89)**

- Opening
  - Requires removal of the top Impact Limiter, bolts and lid
  - Payload is lowered into the package by lifting means (crane, forklift, chain fall, etc)
  - Shoring or cribbing is provided to restrict movement
- NO THERMAL MODERATION OR EXTERNAL CAGING REQUIRED
- Closure
  - Replacement of lid assembly
  - Installation of 24 bolts properly torqued
  - Re-installation of Impact Limiter

## Hypothetical Accident Conditions (71.73)

Safety Factors Obtained from LS Dyna Model Calculations: (assumes maximum payload of 6,500 pounds in all calculations)

- Most Damaging Configuration:
  - CG over Bottom/Top Corner Drop (15 deg)
    - Average Shielded Liner Safety Factor: 5
    - Closure Mechanism (bolt heads, cores, and closure flanges provide an average safety factor of: 10
    - Welds have a safety factor of: 2

## Hypothetical Accident Conditions (71.73)

Puncture Test models reveal excellent puncture resistance, in any configuration.

- Corner of Peg

Most damaging peg configuration requires removal of Impact Limiter(s).

- Edge of Peg

Concentration of energy into a small surface area

Adequate deflection, minimal troughing (1.625")

Minor plastic deformation of Outer Shell (minor thinning)

Thermal Barrier and Inner Shell remain intact and effective

Containment not affected

## Hypothetical Accident Conditions (71.73)

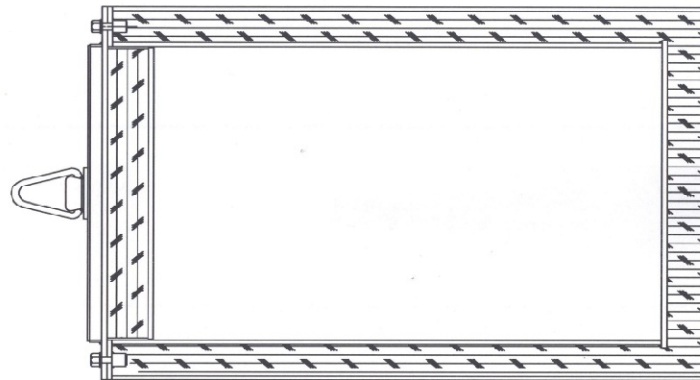
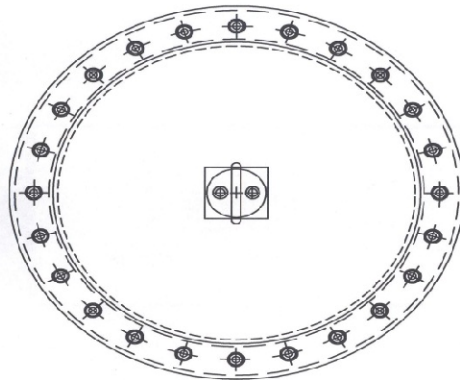
Thermal Test Calculations reveal excellent heat transfer / heat dissipation characteristics.

- Interior Shielded Liner Cavity temperature rises to 371.1°F when package is immersed in 1475° F Thermal Bath for 30 minutes.
- Package interior temperature with 450 Watt payload rises to 345.7°F
- Combined thermal effect of test: Safety factor of 2.1, based upon a phase change of lead occurring at 620°F.



- Fabrication consists of two principal sub assemblies:
  - 1. The Main Package Body (Subpart H; Quality Assurance)
  - 2. Impact Limiter Assemblies (Subpart H; Quality Assurance)

Lower Package Assembly - Reference Only

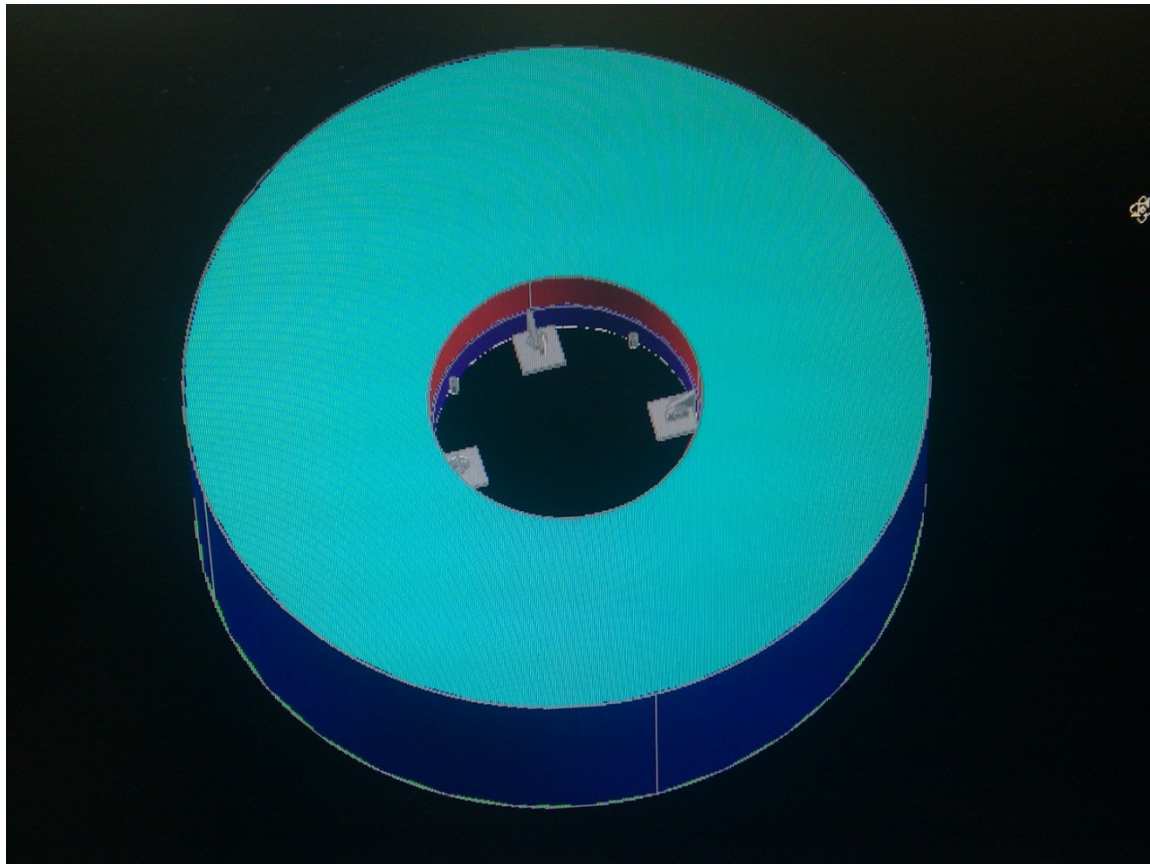


SKETCH-1

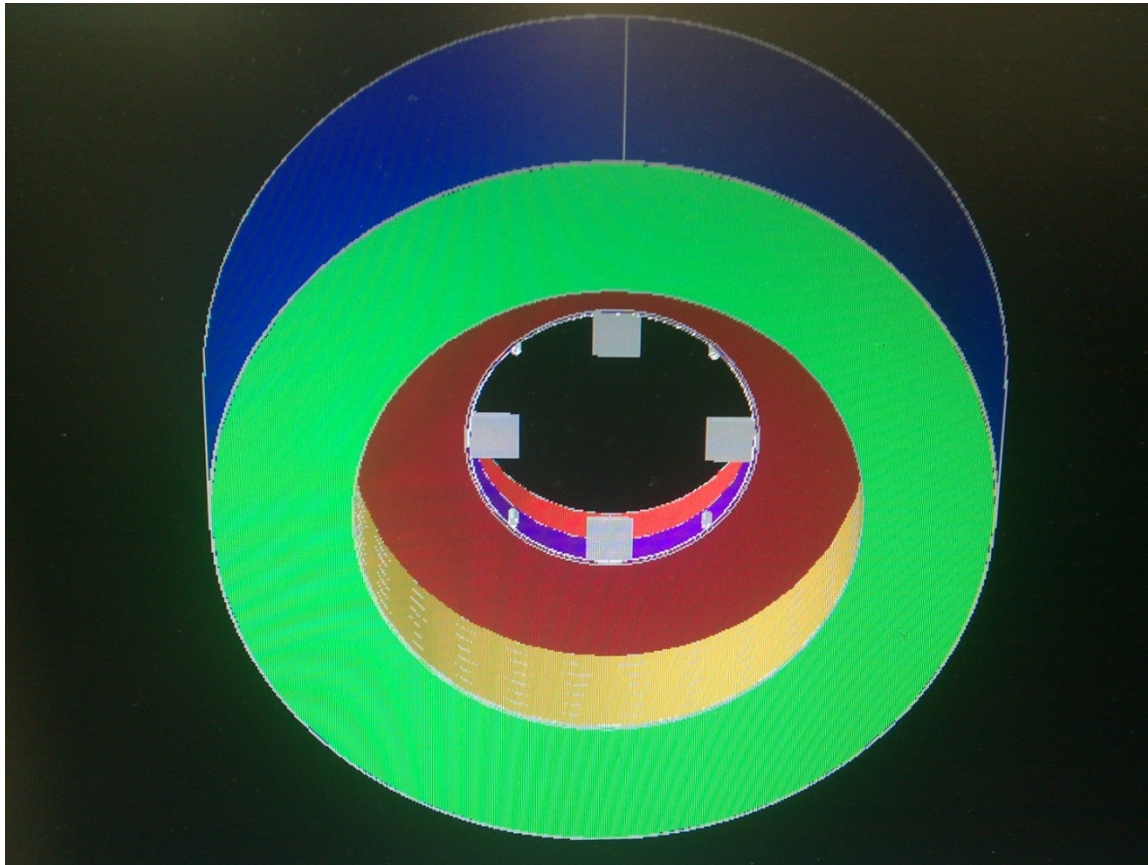
## IMPACT LIMITERS

- TWO
  - One Top (10" thick on top x 12" thick on sides)
  - One Bottom (identical)
    - Affixed as "crowns" to the top and bottom of the main package body and extend down the side of the main package a distance of 24"
  - Foam Filled (General Plastics Last-A-Foam, FR3712)
  - Made from 12 gage, 304 Stainless Steel, fully welded and structurally reinforced to assure maximum transfer of energy from package body to Impact Limiter during transport mishap.
  - Attached to top and bottom of main package body ends at four hardened points

## Impact Limiter - Top View



## Impact Limiter - Bottom View



## CONCLUSION

1. Modeling results indicate favorable package performance.
2. The package is relatively simple in design and has a limited purpose.
3. JLS&A is anticipating provision of a Safety Analysis Report to NRC by June 30, 2012.